

NPIC/TSSG/RED-1896-69
29 October 1969

MEMORANDUM FOR: Executive Director, NPIC

THROUGH : Chief, Technical Services & Support Group
Chief, Research & Engineering Division

SUBJECT : Status Report -- Visual Process Research Program

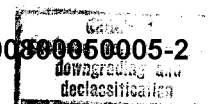
1. The first phase of the Visual Process Research Program is now complete. A wealth of data was collected and analyzed, and many of the findings found application in a variety of situations.

2. Primary attention was devoted to assessing the effect of long-term use of microscopes and other optical aids on the visual performance of Center personnel. A previous Center research effort was reviewed by scientists, the results of which indicated that visual acuity scores decreased during a 7 to 14 month time span. The validity of these findings was questioned on several grounds, and the research program was modified in order to:

- a. test each Center employee who was required to utilize magnification aids in the performance of his duties;
- b. develop and then follow appropriate test procedures administered by highly skilled test administrators;
- c. control for the effects of age on visual performance;
- d. adhere to a rigid test-retest cycle of 6 months;
- e. test for potential "season effects" on visual sensitivity;
- f. develop and implement uniform reporting procedures;
- g. conduct an intensive analysis of the results;

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- b. coordinate Center efforts with the Office of Medical Services and the Center's consulting ophthalmologists;
- i. report the findings to appropriate Center personnel in a timely, understandable fashion.

3. Description of Tests:

- a. Visual acuity, or resolving power,* (monocular and binocular) at near vision (14") and for distance (20')
- b. Vertical phoria* at far (20")
- c. Lateral phoria* at near (14") and at far (20').
- d. Stereo depth* at far (20')
- e. Color discrimination (red-green sensitivity)
- f. Interpupillary distance
- g. Other information:
 - 1.) date of most recent visit to Center's ophthalmologist.
 - 2.) use of eyeglasses
 - 3.) age
 - 4.) job description
 - 5.) general comments

4. Procedures:

Three hundred and sixty four Center employees were divided into six experimental groups, each group representative of the subject population in terms of age (a critical factor in vision research, and one that must be controlled in order to isolate the effects of other variables which might influence visual sensitivity).

* see appendix

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Subjects in Group 1 were tested in June, 1968, and retested 6 months later (Dec. 1968). Group 2 subjects were tested in July 1968 and retested in January, 1969, and so forth. All tests were conducted by personnel from the Office of Medical Services/Psychological Services Staff who had been trained by the author. The Office of Medical Services nurse assigned to the Center was responsible for all scheduling & record keeping.

5. Results: The several analyses of the results indicated:

- a. no significant differences in scores on any parameter among the 6 groups during the initial 6 month test phase;
- b. no significant differences in scores on any parameter among the same 6 groups during the 6 month retest phase;
- c. no significant differences in test vs. retest scores on any parameter for the results of each group analyzed independently;
- d. group averages were at least comparable, if not superior, to national norms for all tests except lateral phoria at 20', where a statistically significant exophoria* of 2.0 to 2.5 prism diopters was found. No major significance was placed in this finding by the several experts consulted. Furthermore, the results agree with data supplied to the Center by U.S. Naval School of Aviation Medicine.
- e. average interpupillary distances was approximately 64 mm., but the range of scores indicated that a few subjects would find it difficult if not impossible to use binocular instruments;
- f. fewer than 40 subjects were found to be red-green color deficient;
- g. the vast majority of the subjects were capable of resolving the most difficult stereo test in the test instrument;

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- h. no effects of season on visual acuity were apparent, unlike the situation where the amount of sunlight associated with seasons was found by the Navy to influence visual sensitivity (dark adaptation);
- i. of all the interpreters who had prescription eyeglasses (some 65% of the subject population), approximately 75% of them wore their glasses when using magnification aids to interpret imagery (a matter of convenience), despite the fact that the microscopes can correct for refractive errors, but not astigmatism.

6. Selected Application of Results:

- a. Earlier indications that continued use of microscopes was having a deleterious effect on visual acuity were not corroborated in the present study, suggesting that inappropriate test procedures were followed in the previous test program.
- b. The names and records of the 40 individuals who were judged by the author to demonstrate the poorest visual performance in the test program were submitted to the Center's consultant ophthalmologist for further review. Results are expected within 30 days, according to an Office of Medical Services spokesman.
- c. Once that information is received, work will be devoted to further specifying the visual requirements for photo interpretation. The Office of Medical Services has agreed to provide detailed vision information to the Center on all applicants.
- d. Visual acuity scores were correlated with mensuration accuracy. [] included this analysis in their mensuration research program, and the results indicated that the two measures are not related -- due primarily to the fact that the photogrammetrist are typically well corrected and can compensate for any residual refractive errors with adjustments available on their comparator optics.
- e. The IEG was recently provided the names of 38 interpreters who were judged by the author to be at least marginally deficient in color perception. Very liberal criteria were employed in selecting these people, and the fact that one's

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name appears on the list need not necessarily indicate a true color deficiency. The information was provided to insure that IEG management is aware of color deficient PIs who might be tasked with the exploitation of color materials, or worse, with the determination of the intelligence value of color imagery. Stimulus materials for a more sensitive color test have been secured, and a follow up color test will be administered if so requested by IEG.

- f. A rather extensive review of the literature on color vision has been in progress by the author for some time. This effort is directed toward the exploitation of color materials, and is in support of one portion of the color-oriented research program in R&D under the direction of [REDACTED] 25X1

- g. A stereo test more sensitive than the one employed in the survey was developed by [REDACTED] for the Microscope Design Criteria study. The test was recently evaluated by this office as a means of selecting photogrammetrists with particularly high stereo acuity. The results of the preliminary test are encouraging, and the recommendation has been made to continue employing the test as a screening device. The stimulus materials utilized in the tests are presently being calibrated by [REDACTED] 25X1

- h. One early product of the vision survey was an age/job description profile for the Center personnel who participated in the program. The information is now of historical use only, and it should be updated to reflect the organizational & personnel changes that have occurred in the past year or so.

- i. Several commercial firms that employ large numbers of microscopists were asked if long term use of magnification aids influenced visual sensitivity. A surprisingly detailed and candid reply was received from [REDACTED] which indicated that "...no noticeable eye deterioration exists as the result of long use of microscope. On the contrary, [REDACTED] doctors are convinced this tends to stall normal age-related eye deterioration." 25X1

- j. The plight of several IEG interpreters with unusually small interpupillary distances was discussed with IEG management,

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since it was determined that it would be difficult if not virtually impossible for them to utilize binocular instruments due to a minimum instrument IPD of approximately 55 mm. Similar information was provided RED personnel concerned with microscope design.

- b. Results from the survey concerned with the use of eyeglasses when viewing through microscopes were provided to RED personnel tasked with designing microscopes which have, by virtue of elaborate optical characteristics, an exceedingly small exit pupil. The exit pupil in one system is so limited that it would be impossible for an interpreter to wear corrections other than contact lenses. On the basis of the survey results, it was concluded that acuity adapters should be provided for at least those interpreters afflicted with marked astigmatism.

7. [REDACTED] ATB/RED is currently drafting a detailed report on the Visual Process Research Program.

[REDACTED]
Chief, Human Factors Section, ATB

Distribution:

Orig - Addressee

1 - TSSG

✓ 1 - TSSG/RED

2 - RED/ATB/ [REDACTED]

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(29 October 1969)

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APPENDIX

VISUAL ACUITY: Ability to continue to see as separate and clear the details of the visual object as the details are made smaller and closer together - resolving power.

PHORIA: Angular displacement of a covered (occluded) eye when the fellow eye is fixating a distant point - measured in prism diopters (displacement in centimeters/distance in meters).

ESOPHORIA: occluded eye converges

EXOPHORIA: occluded eye diverges

HYPERPHORIA: occluded eye deviates upward

ORTHOPHORIA: occluded eye parallel with fellow eye

HYPEROPIA OR HYPERMETROPIA: (cannot see near objects clearly) Commonly called far-sightedness; a refractive error in which the light rays tend to focus behind the retina due to an abnormally short eyeball or to a deficient refracting apparatus. The condition is corrected by ocular accommodation or by convex lenses.

MYOPIA: (Cannot see near objects clearly) Commonly called near-sightedness; anterior surface of the ocular lens cannot buldge appropriately, thus the eye is incapable of focusing distant objects.

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